

Automation of Safety Analysis with SysML Models

Completed Technology Project (2012 - 2012)



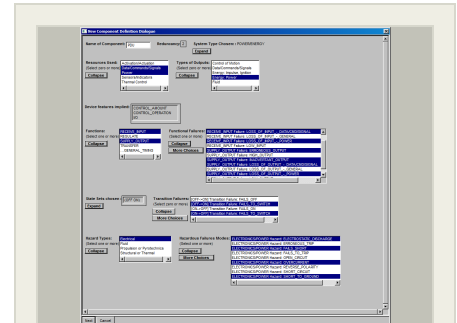
Project Introduction

To provide economical, reliable and safe access to space, design weaknesses should be identified earlier in the engineering life cycle, using model-based systems engineering. The slow manual approach to performing Failure Modes and Effects Analysis (FMEA) is a barrier to early identification of weaknesses. To semi-automate the identification of failure modes and causes use a prototype FMEA Assistant, including a library with standard terminology, to classify components associated with failure modes and automatically identify candidate functions, infrastructure and failure modes. This automation will reduce cost and increase coverage, standardization and reuse. Early identification of design weaknesses can substantially reduce rework costs later in the life cycle, which are all too common in the testing phase. Use of SysML will closely link safety analysis with the overall engineering process, resulting in smoother collaboration and safer vehicles and missions. The resulting reusable model would become part of the model-based system engineering process.

This project was a small proof-of-concept case study, generating SysML model information as a side effect of safety analysis. A prototype FMEA Assistant was used to semi-automate safety analysis that identifies failure modes and causes, using a library with standard SysML-compatible terminology to classify components associated with failure modes and to automatically identify candidate functions, infrastructure and failure modes. FMEA analysts select from standard functions and failures to systematically narrow down failure mode selection (presented in automatically created pick lists). Standard terminology from an existing Aerospace Ontology is used to classify components and automatically identify candidate functions and failure modes. With automatically created pick lists, analysts can easily and correctly select standard functions and failures for a SysML architecture model as a side effect of using FMEA Assistant. A white paper reports on a concept for using SysML profiles for safety analysis, to standardize FMEA-related terminology for reuse in several types of safety analysis (hazard analyses, fault trees, reliability block diagrams). See related project: Failure Modes and Effects Analysis (FMEA) Simulation Tool

Anticipated Benefits

There are benefits for both safety analysis and engineering analysis. Semi-automation of FMEA will reduce cost and increase coverage, standardization and reuse. FMEA could be significantly improved by using SysML models and standard terminology to classify components and automatically identify candidate functions, infrastructure and failure modes. Early identification of design weaknesses can substantially reduce rework costs later in life cycle. Use of SysML will closely link safety analysis with the overall engineering process, resulting in smoother collaboration and safer vehicles and missions. The resulting reusable model would become part of the model-based



Project Image Automation of Safety Analysis with SysML Models

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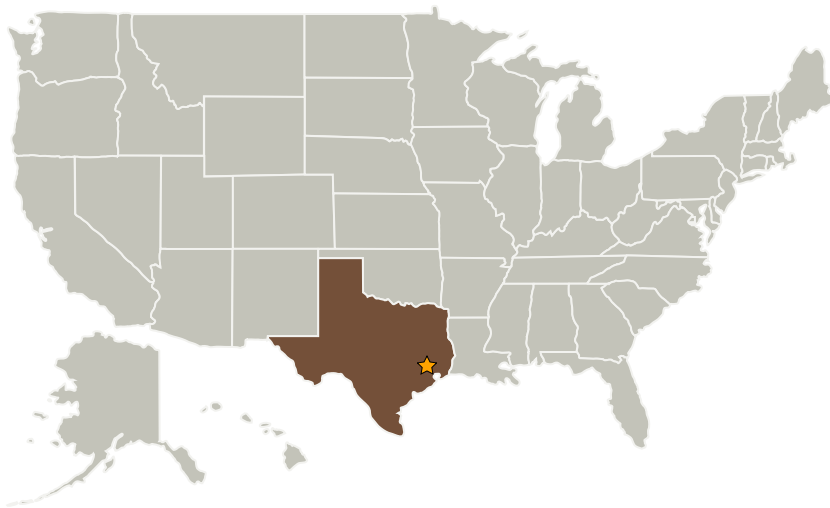
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system engineering process.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★ Johnson Space Center(JSC)	Lead Organization	NASA Center	Houston, Texas
Jacobs Engineering Group, Inc.	Supporting Organization	Industry	Dallas, Texas

Primary U.S. Work Locations

Texas

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Johnson Space Center (JSC)

Responsible Program:

Center Innovation Fund: JSC CIF

Project Management

Program Director:

Michael R Lapointe

Program Manager:

Carlos H Westhelle

Project Manager:

Jane T Malin

Principal Investigator:

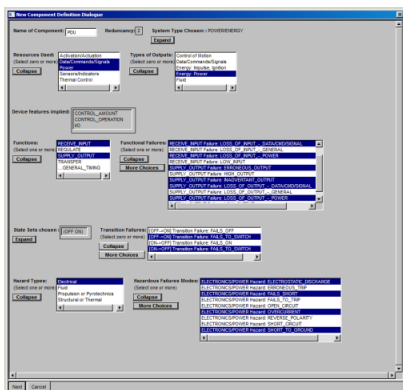
Jane T Malin

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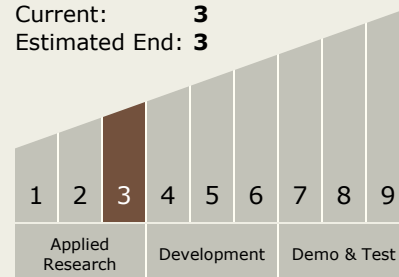
Images

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Project Image Automation of Safety Analysis with SysML Models
 (<https://techport.nasa.gov/image/2265>)

Technology Maturity (TRL)

Start: **3**
 Current: **3**
 Estimated End: **3**



Technology Areas

Primary:

- TX11 Software, Modeling, Simulation, and Information Processing
 - └ TX11.5 Mission Architecture, Systems Analysis and Concept Development
 - └ TX11.5.2 Tools and Methodologies for Performing Systems Analysis